Appendix A

Automated Template for Post-Construction Storm Water Quality Plan

(Provided in Electronic Format Only)

http://www.placer.ca.gov/lowimpactdevelopment

Appendix B
BMP Fact Sheets

STREAM SETBACK AND BUFFERS

Fact Sheet SDM-1

Also known as: Aquatic bu ers, riparian setbacks

DESCRIPTION

Stream setbacks and bu ers are vegetated areas that exist or are established along a stream system, lake, reservoir, or wetland area where development is restricted or prohibited. They consist of trees, shrubs, and herbaceous vegetation th t separates and physically protects aquatic e osystems and habitats from future disturbance or encroachment. Stream setbacks and bu ers can either be preserved natural areas or engineered BMPs specifi ally designed to treat stormwater runoff b fore it enters a stream, shore, or wetland.

Stream zone avoidance in south Placer County.
Source: Placer County Conservation Pla

ADVANTAGES

- Can be used as part of a treatment train with other BMPs.
- Can provide high level water quality treatment with proper design.
- Limits development in floodplain a eas.
- Improves aesthetics
- Improves quality of aquatic e osystems and habitats.
- Serves as foundation or present or future greenways.

LIMITATIONS

- A minimum stream setback and bu er width of 500 feet is required to obtain stormwater runoff eduction credits.
- Restrictions on vailable space for development.
- Potential e tablishment of nuisance species.
- Not suitable for treating poi t-source stormwater discharges (i.e. end of pipe).
- Can be difficult o delineate and demarcate stream setback and bu er widths.
- Natural stream shifts m y alter stream setback and bu er widths.

KEY DESIGN FEATURES

The ability of a particular tream setback and bu er to function ecti ely depends on how well the bu er is planned or designed. In general, the following guidelines should be followed (for more information see *The Architecture of Urban Stream Buffers, The Practice of Watershed Protection: Article 39*):

- Maintain the stream setback and bu er in an ungraded and uncompacted condition
- Protect the stream setback and bu er from vehicular traffic o reduce compaction.
- The contributing verland slope should be 5% or less unless a level spreader is used.
- Adopt a vegetati e target based on predevelopment plant community.
- Expand the width of the middle zone to pick up wetlands, slopes and larger streams.
- Use clear and measurable criteria to delineate the origin and boundaries of the bu er.

STREAM SETBACK AND BUFFERS

Fact Sheet SDM-1

Photo Source: USGS

- The number and conditions or stream and bu er crossings should be limited.
- The use of bu er for stormwater runoff t eatment should be carefully prescribed.
- Bu er boundaries should be visible before, during, and a er construction
- Bu er education and e forcement are needed to protect bu er integrity.

A minimum stream setback and bu er width of 500 feet is required to obtain runoff olume reduction c edits. However, smaller stream setbacks and bu ers may be required by local jurisdictions ven if runoff olume reduction c edits are not obtainable. For areas within the West Placer County Phase II MS4 Permit boundary, local ordinances should be reviewed to determine required stream setback widths at a particular si e.

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construction S orm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retention olume (V_{ret}) of the Stream Setback and Bu er. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percentile, 24-hour design torm for Regulated Projects. The equation or determining V_{ret} is as follows:

$$V_{ret} = A_{imp} * V_{85} * (1/12)$$

Where:

V_{ret} = stormwater retention olume (^{3});
A_{imp} = impervious area draining to the stream setback (^{2}); and
V_{85} = Runoff volume from 85th percentile, 24-hour design storm (in)

RUNOFF REDUCTION CREDIT REQUIREMENTS

- A minimum stream setback and bu er width of 500 feet is required to obtain runoff olume reduction c edits.

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance practices, tate the parties esponsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specific inspection checkl t. At a minimum, maintenance shall include the following:

- Establish and manage distinctions of al wable and unallowable uses in each bu er zone.
- Clearly identi y bu er boundaries and maintain clear signs or markers defining bu er extents.
- Inspect newly established vegetation semi-annually o determine if landscape maintenance is needed (reseeding, irrigation, trimmin , weed removal, etc.).
- Inspect disturbed and revegetated slopes semi-annually for erosion and repair as needed.
- Inspect trails, paths, and bridges annually for erosion or structural issues and repair as necessary.

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STREAM SETBACK AND BUFFERS

Fact Sheet SDM-1

REFERENCES

Schueler, T. 2000. The Architecture of Urban Stream Bu ers, The Practice of atershed Protection: Article 39 Center for Watershed Protection, Elli ott Cit , MD. Pages 225-233. Available for download at: http:// ww.cwp.org/online-watershed-library/cat_view/63-research/70-watershed

Stormwater Center, Aquatic Bu ers Fact Sheet: Bu er Zones. Available online at: http:// ww.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool3_Bu ers/Bu erZones.htm

U.S. Environmental Protection A ency. Aquatic Bu er Model Ordinance. Available online at: http:// ater.epa.gov/polwaste/nps/upload/2002_09_19_NPS_ordinanceuments_Bu er_model_ordinance1.pdf

SOIL QUALITY IMPROVEMENT AND MAINTENANCE

Fact Sheet SDM-2

Also known as: Soil amendments, engineered soils

DESCRIPTION

The quality of existing soils on a p oject site can be improved by implementing soil amendments that alter the physical, chemical, and biological characteristics of the soil. Soil amendme ts can help restore disturbed soils by increasing organic ma er content and reducing compaction. Amendme ts can also make soils with high clay content (i.e. hydrologic soil groups [HSG] C and D) more suitable to receive and fil er/infil rate site runo . Soil amendments consist of humus such as compost and aged manure; brous materials such as peat, wood chips, and hardwood bark; inorganic materials such as vermiculite and perlite; and other soil conditione s and fertili ers as appropriate. The practice an increase in ltration ates, plant survival rates and health, enhance root growth, provide erosion stabilization, and dec ease need for irrigation and ertili ation.

Photo Source: U.S. EPA

ADVANTAGES

- Improves soil infilt ation ates.
- Reduces surface runoff qua tities and osion.
- Improves soil filt ation apabilities and pollu ant removal.
- Enhances plant survival rates and health.
- Decreases need for landscape irrigation and ertili ation

LIMITATIONS

- Not recommended for slopes steeper than 3:1.
- Could result in increased water table elevations, l teral groundwater fl ws and other conditions th t may create unwanted seepage or flooding t down gradient locations

KEY DESIGN FEATURES

The type, mix, and amounts of soil amendments will vary from site to site in response to the local soil conditions and type of desired vegetation. Exi ting soils mu t be sampled and analyzed to determine soil characteristics and ide ti y appropriate amendment types and quantities. Soil amendm ts should consist primarily of compost mixed with other materials as necessary. Detailed material and testing speci ations or compost are provided in the Low Impact Development Center's Soil Amendment – Compost Specifi atio .

Before soil amendments are applied, use a rototille , soil ripper, or other equipment to loosen existing soils o the desired depth. Loosening soils below the depth of the amended soil layer will further improve infilt ation. Design depths of soil amendment areas range from 6 inches minimum to several feet. Soil amendments should then be applied over the loosened soil area and incorporated into the existing soil u til fully mi ed. The amended soil should then be watered thoroughly and allowed to settle or at least one week prior to final g ading. Seeding and planting should be performed immediately a er final g ading is complete.

SOIL QUALITY IMPROVEMENT AND MAINTENANCE

Fact Sheet SDM-2

SIZING DESIGN GOALS AND REQUIREMENTS

A qualified Geo echnical Engineer, Geologist, or Hydrogeologist should be consulted for the implementation of this Site Design Measure. The Post-Construction S orm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retention olume (V_{ret}) of the soil quality improvement and maintenance area. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percentile, 24-hour design torm for Regulated Projects. The equation or determining V_{ret} is as follows:

$$\mathbf{V_{ret} = (A_{pond} * D_{pond}) + (A_{sa} * D_{sa} * n)}$$

Where:

V_{ret} = stormwater retention olume (^{3});
A_{pond} = ponding area (^{2});
D_{pond} = ponding depth (ft)
A_{sa} = soil amendment area (^{2});
D_{sa} = depth of amended soil (ft); an
n = porosity of amended soil

Soil quality improvement and maintenance areas must meet the ideal bulk densities p ovided in Table 1 below. Soil porosity (n) in the above equation is alculated as follows:

$$\mathbf{n = 1 - (\rho_{sa} / 2.65\ g/cm^3)}$$

Where:

n = porosity of amended soil; and
ρ_{sa} = bulk density of amended soil (g/cm^3)

Table 1. Ideal Bulk Densities or Amended Soils (grams/cm^3)

Sands, loamy sands	<1.6
Sandy loams, loams	<1.4
Sandy clay loams, clay loams	<1.4
Silts, silt loams	<1.3
Silt loams, silty clay loams	<1.1
Sandy clays, silty clays, clay loams	<1.1
Clays (>45% clay)	<1.1

Data source: USDA NRCS

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance practices, state the parties esponsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specific inspection check ist. At a minimum, maintenance shall include the following:

- Soil should be planted and mulched a er installation. No part of the si e should have bare soil exposed.
- Compaction of amended soils should be voided.
- Amended soils should be inspected annually for signs of compaction, aterlogging, loss of vegetated cover, or erosion.
- Correcti e actions include appli ation of additional amendm ts and mechanical aeration

REFERENCES

Low Impact Development Center, Inc. 2003. Soil Amendment - Compost Specifi ation. vailable online at: http:// ww.lowimpactdevelopment.org/epa03/soilamend.htm

Low Impact Development Center, Inc. 2010. Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies. Available online at: htt s://www.casqa.org/sites/default/files/d wnloads/socallid-manual-final-040910.pd

U.S. Environmental Protection A ency. 2007. The Use of Soil Amendments for Remediation, evitalization, and euse. Available online at: http://nepis.epa gov/Exe/ZyPDF.cgi/60000LQ7.PDF?Dockey=60000LQ7.PDF

TREE PLANTING AND PRESERVATION

Fact Sheet SDM-3

Also known as: Interceptor Trees

DESCRIPTION

Photo Source: wfrc.org

Tree planting and p eservation i volves planting of n w trees and preservation of existing t ees to reduce stormwater runoff olumes from a new development or redevelopment site. Trees intercept rain water on their leaves and branches before it lands on impervious surface below, allowing rain water to evaporate or run down the branches and trunk of the tree where it readily infilt ates into the soil. Trees absorb infilt ated runoff th ough their roots and further reduce stormwater runoff y means of transpiration. Trees also provide shade over impervious surfaces which reduces the "heat island" e ects of urban areas. Tree planting and p eservation should be implemented on residential lots, th oughout landscape corridors, in commercial and industrial parking lots, and along street frontages.

ADVANTAGES

- Reduces stormwater runoff olumes and the amount of pollutants entering downstream BMPs and the storm drain system.
- Enhances aesthetic alue.
- Provides shade to cool pavement and reduces surface runoff emperatures.
- Aids in removal of air pollutants and noise reduction
- Trees required by the permitting ency may be counted as interceptor trees.
- Establishes habitat for birds and other pollinators like bu erflies and bees
- Extends life of asphalt paving.

LIMITATIONS

- Great care must be exercised when work is conducted near existing t ees to be preserved.
- New and existing t ees may require irrigation
- New and existing t ees must have adequate setback from buildings, structures, and utilitie
- Incorrect tree selection an result in high irrigation osts and pest infestation.
- Runoff eductions a e dependent on the canopy area over the impervious surfaces created by the project.

KEY DESIGN FEATURES

- Appropriate new trees must be selected according to site and soil characteristics. efer to the Local Landscape Design Guidelines for more information.
- Involve an arborist in the design process.
- Fire safety must be a consideration in a eas with increased risk of fi e hazard.

TREE PLANTING AND PRESERVATION

Fact Sheet SDM-3

- Consider the future size/canopy and root zone of the fully-grown mature species when locating t ees on the site, providing proper clearance from building foundations, p vement and overhead/underground utilities Ideally, provide a setback of 10 to 15 feet from the expected 10-year canopy to overhead lines.
- Utili e approved root barriers when trees are planted in near proximity to infrastructure, per the local permitting ency standards.
- Evergreen trees provide the greatest benefit o water quality due to their retention of le ves throughout the rainy season.
- Install irrigation ystems according to local specifi ations.
- Do not install grass or turf within 24 inches of the tree trunk.
- Use mulch around the base of newly planted trees to reduce irrigation needs and p otect bare soils from erosion. Consult an Arborist or nursery on appropriate amounts and types.

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construcon St orm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retenon v olume associated with tree planng and pr eservaon. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percenle, 24-hour design storm for Regulated Projects. The equaon f or determining V_{ret} is as follows:

$$V_{ret} = ((n_e * 218) + (n_d * 109) + A_{tc}) * (V_{85} * 1 \text{ ft}/12\text{in})$$

Where:

V_{ret} = stormwater retenon v olume (^{3});
n_e = number of new evergreen trees;
n_d = number of new deciduous trees;
A_{tc} = canopy area of existing trees to remain on the property (ft^2)
V85 = runoff volume from the 85th percentile, 24-hour design storm (in)

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance pracces, s tate the pares r esponsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specic inspecon checklis t. At a minimum, maintenance shall include the following:

- Irrigate as necessary to establish and maintain trees.
- Remove fallen leaves and debris annually to prevent materials from being transported in stormwater runo .
- Prune dead vegetaon fr om trees on a regular basis.
- Minimize the use of chemical ferliz ers and pescides.
- Maintain lawn and turf at least 24 inches from trunk of tree.
- Remove and replace dead trees as needed.

REFERENCES

Placer County Planning Services Division. 2013. Placer County Landscape Design Guidelines. Available online at: hp://w ww.placer.ca.gov/~/media/cdr/Planning/documents/DesignGuides/Landscape%20 Design%20Guidelines.pdf

Sacramento County, et al. 2014. Stormwater Quality Design Manual for the Sacramento Region. Available online at: hp://w ww.beriverfriendly.net/docs/les/Mas ter%20Stormwater%20Quality%20Manual%202014_FINAL_W%20 APPEND_W%20COVER.pdf

ROOFTOP AND IMPERVIOUS AREA DISCONNECTION

Fact Sheet SDM-4

Including: Downspout Disconnecon, P avement Disconnecon, and Flo wpath Disconnecon.

OVERVIEW

Roo op disconnecon. Sour ce: LID Center

Roo op and impervious area disconnecon ar e techniques that reduce the volume of stormwater delivered to storm drains or receiving waters by disconnecng the runo fr om these areas and redirecng it t o permeable locaons tha t promote soil ltr aon and runo in ltr aon. This c an be accomplished by conguring r oof gu er downspouts and impervious areas (e.g., driveways, pathways, small parking areas, and paos) t o discharge runo in to landscaped areas, rain barrels and cisterns, or designed stormwater management areas such as vegetated swales, stream bu ers, amended soil areas, and bioretenon cells.

This Fact Sheet is organized to include separate secons f or roo op disconnecon, and imper vious area disconnecon. Details on specic s tormwater management strategies discussed herein, including stream setbacks and bu ers, soil quality improvement and maintenance, porous pavement, vegetated swales, rain barrels and cisterns, and bioretenon, c an be found in other Fact Sheets included in this manual.

ROOFTOP DISCONNECTION

Roof drains and downspouts can be disconnected from the storm drain system by roung dischar ge to vegetated areas or into subsurface inltr aon s ystems. The two roo op disconnecon me thods discussed in this Fact Sheet include splash blocks and bubble-up emi ers which both provide means of dissipang o w energy and spreading o ws over the pervious area. Roo op drainage is also ideal for harvest/reuse applicaons; r efer to the Rain Barrels and Cisterns Fact Sheet for more informaon.

SPLASH BLOCK

Splash blocks are a low tech and cost ecien t opon to hard piped downspout systems. Exisng do wnspouts can easily be retro ed using splash blocks that reduce the velocity and impact of runo dischar ging from downspouts. This reduces soil erosion and promotes inltr aon.

ADVANTAGES

- Reduces peak o w rates and total runo v olumes.
- Directs runo a way from foundaons and s tructures.
- Simple to implement in retrot applic aons.
- Reduces the size of downstream BMPs.

LIMITATIONS

- Adjacent buildings and overo w requirements need to be considered in design.
- Only appropriate for sites with pervious areas near downspouts.
- If groundwater exists within two feet of the ground surface, seasonal uctua ons ma y result in periods of decreased inltr aon and/ or standing water.
- Runo r educon cr edits cannot be claimed for roo op disconnecon if cr edits for stream setbacks and bu ers or vegetated swales are being claimed in the same sub-watershed areas (DMA).

ROOFTOP AND IMPERVIOUS AREA DISCONNECTION

Fact Sheet SDM-4

KEY DESIGN FEATURES

- Sites should be evaluated to ensure that splash blocks won't have negav e impacts.
- Rain water must be directed away from foundaons and f oongs.
- Do not compact soils in areas where inltr aon of s torm water is planned.
- Downspouts must extend at least six feet from a basement and two feet from a crawl space or concrete slab.
- The area of roo op connecng t o each downspout must be 600 square feet or less.
- Downspouts should not be directed to paved areas or across sidewalks.
- Landscaped areas receiving roof water should be adequately sized to prevent runo or er osion. An impervious:pervious rao of 2:1 should be applied.
- Flow spreaders should be implemented downstream of splash blocks for sites with steep slopes.

BUBBLE-UP EMITTER

Bubble-up emi ers funcon v ery much like splash blocks, but allow for roof drainage to be discharged into vegetated areas that are not directly adjacent to the building. Downspouts are connected to underground pipes then released through a valve that opens with water pressure.

Bubble-up emi er installaon.
Photo Source: green-weaver.com

ADVANTAGES

- Reduces peak o w rates and total runo v olumes.
- Directs runo a way from foundaons and s tructures.
- Can discharge to vegetated areas not adjacent to buildings.
- Reduces the size of downstream BMPs.

LIMITATIONS

- Overo w requirements need to be considered in design.
- Increased maintenance and cost over splash blocks.
- Runo r educon cr edits cannot be claimed for roo op disconnecon if cr edits for stream setbacks and bu ers or vegetated swales are being claimed in the same sub-watershed areas (DMA).

KEY DESIGN FEATURES

- The area of roo op connecng t o each downspout should be 600 square feet or less.
- Landscaped areas receiving roof water should be adequately sized to prevent runo or er osion. An impervious:pervious rao of 2:1 should be applied.
- Overo w systems and backo w prevenon should be inc orporated into design.
- Piping and valves must be able to convey the design storm event.

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ROOFTOP AND IMPERVIOUS AREA DISCONNECTION

Fact Sheet SDM-4

IMPERVIOUS AREA DISCONNECTION

Disconnecng imper vious areas involves roung runo fr om paved areas such as roads, parking lots, pathways, courtyards, and paos to adjoining vegetated areas as sheet o w. As the sheet o w passes over vegetated areas it is lt ered by the soil and inltr ated thereby reducing the volume of stormwater discharged to receiving waters or the storm drain system. Examples of vegetated areas to accept sheet o w runo include v egetated swales, stream bu ers, amended soil areas, and bioretenon cells. Another alt ernav e for disconnecng impervious surfaces involves implementaon of per vious pavement; refer to the Pervious Pavement Fact Sheet for more informaon.

Impervious Area Disconnection.
Photo Source: City of Kitchener, ON

In general, curb and gu er should be avoided to reduce concentrated o ws from impervious surfaces. However, curb cuts can be e ecv ely implemented to direct runo fr om roads and parking lots into permeable stormwater management areas. Level spreaders should be considered for energy dissipaon and pr omoon of shee t o w to the pervious areas. This technique works well for retrong e xisng sit es at a relav ely low cost. Care must be taken to provide adequate clearances between vegetated inltr aon ar eas and building foundaons and pa ved surfaces.

ADVANTAGES

- Reduces peak o w rates and total runo v olumes.
- Eliminates need for stormwater conveyance infrastructure.
- Promotes groundwater recharge and is aesthec ally pleasing.
- Reduces the size of downstream BMPs.

LIMITATIONS

- Soil permeability may limit use of exisng v egetated areas.
- Not suitable for sites with high concentraons of oil & gr ease or potenal spills.
- Could result in increased water table elevaons, la teral groundwater o ws and other condions tha t may create unwanted seepage or ooding a t down gradient locaons.
- Runo r educon cr edits cannot be claimed for impervious area disconnecon if cr edits for stream setbacks and bu ers are being claimed in the same sub-watershed areas (DMA).

KEY DESIGN FEATURES

- The area of impervious surface discharging to a single vegetated area must be 5,000 square feet or less.
- The size of the pervious area receiving runo should be a t least 50% of the contribung imper vious area (i.e. use a impervious:pervious rao of 2:1).
- The maximum contribung imper vious o w length should be less than 75 feet. If equal or greater than 75 feet, a storage device (e.g. French drain, bioretenon ar ea, gravel trench) should be implemented as a bu er prior to discharging to the impervious area.
- Water barriers may be required when inltr ang adjacen t to paved surfaces in order to prevent undermining of pavement and baserock.
- If o w is to be introduced through curb cuts, place pavement slightly above the elevaon of the the per vious area. Curb cuts should be at least 12 inches wide to prevent clogging.

ROOFTOP AND IMPERVIOUS AREA DISCONNECTION

Fact Sheet SDM-4

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construcon St orm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retenon v olume (V_{ret}) associated with roo op and impervious area disconnec on. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percenle, 24-hour design storm for Regulated Projects. The equaon f or determining V_{ret} is as follows:

$$\mathbf{V_{ret} = A_{imp} * V_{85} * (1/12)}$$

Where:

V_{ret} = stormwater retenon v olume (^{3});

A_{imp} = impervious drainage area (^{2}); and

V_{85} = Runoff volume from the 85th percenle, 24-hour design storm (in)

RUNOFF REDUCTION CREDIT REQUIREMENTS

- Downspouts and any extensions must extend at least six feet from a basement and two feet from a crawl space or concrete slab.
- The area of roo op connecng t o each disconnected downspout must be 600 square feet or less.
- Roof runo fr om the design storm must be fully contained in a landscaped area.
- The impervious area discharging to an impervious disconnecon ar ea must be than 5,000 square feet or less.
- The maximum contribung imper vious o w path length for impervious area disconnecon mus t be less than 75 feet or, if equal or greater than 75 feet, a storage device (e.g. French drain, bioretenon ar ea, gravel trench) is required to achieve the required disconnecon leng th.
- Credits for roof runo and imper vious area disconnecon c annot be obtained if stream setbacks and bu ers are used within the same Drainage Management Area.
- Credits for roof runo disc onnecon c annot be obtained if vegetated swales are used within the same Drainage Management Area.

REFERENCES

Low Impact Development Center, Inc. 2010. Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies. Available online at: hp s://www.casqa.org/sites/default/les/do wnloads/socallid-manual-nal-040910.pdf

Sacramento County, et al. 2014. Stormwater Quality Design Manual for the Sacramento Region. Available online at: hp://w ww.beriverfriendly.net/docs/les/Mas ter%20Stormwater%20Quality%20Manual%202014_FINAL_W%20APPEND_W%20COVER.pdf

Eciency f actors for di erent types of porous pavements are provided in Table 1 below.

Table 1. Porous Pavement Efficiency actors

Pervious Concrete or Asphalt (15% void space)	0.60
Modular Block Pavement (20% void space)	0.75
Reinforced Grass Pavement	1.00
Cobblestone Block Pavement (8% void space)	0.40

Source: Urban Drainage and Flood Control District, Denver, CO, Urban Storm Drainage Criteria Manual Volume 3 – Best Management Pracces, September, 1999 (Rev. June, 2002)

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance pracces, state the pares r esponsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specic inspecon checkl ist. At a minimum, maintenance shall include the following:

- Post signs idenf ying porous pavement areas.
- Keep landscaped areas well-maintained and prevent soil from being transported onto the pavement.
- Clean the surface using vacuum sweeping machines.
- If roune cleaning does not r estore inltr aon r ates, then reconstrucon of part of the por ous pavement may be required.
- For modular and cobblestone block, periodically add joint material (sand) to replace material that has been transported or removed.
- Monitor regularly to ensure that the paving surface drains properly a er storms.
- Do not seal or repave with impermeable materials.
- Inspect the surface annually for deterioraon.
- Reinforced grass requires mowing and periodic reseeding to ll in bare spots.
- Clean out underdrain systems at regular intervals.
- Inspect outlets annually and maintain as needed.

REFERENCES

Low Impact Development Center, Inc. 2010. Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies. Available online at: hp s://www.casqa.org/sites/default/les/do wnloads/socallid-manual-nal-040910.pdf

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VEGETATED SWALE

Fact Sheet SDM-6

Also known as: Bioretenon Swale, Treatment Swale, and Grassed Swale

DESCRIPTION

Grassed swale. Photo Source: EPA

Vegetated swales are essenally bior etenon cells that are congur ed as linear channels, but are typically not designed with an engineered soil matrix and underlying gravel layer below the vegetaon layer to accommodate addional tr eatment, storage, and inltr aon. The y funcon as a soil and plant-based ltr aon and in ltr aon f eature that removes pollutants through a variety of natural physical, biological, and chemical treatment processes. Vegetated swales are open, shallow channels with vegetaon c overing the side slopes and bo om that collect and slowly convey stormwater runo t o downstream discharge points. They are designed to treat runo thr ough vegetaon ltr aon, biologic al uptake, evapotranspiraon, and/ or inltr aon in to the underlying soils. They trap parcula te pollutants (suspended solids and trace metals), promote inltr aon , and reduce the ow velocity of storm water runo .

Vegetated swales can serve as part of a storm water drainage system and can replace curbs, gu ers and storm sewer systems. They are best suited to capture runo fr om small impervious areas and should not be implemented in areas with highly contaminated runo . They can be used as part of treatment train approach and are e ecv e at providing pretreatment for other BMPs.

ADVANTAGES

- Reduces peak o w rates and total runo v olumes.
- Provides e ecv e pretreatment for downstream BMPs by trapping, lt ering, and inltr ang parcula tes and associated pollutants.
- Can serve as a cost-e ecv e alternav e to tradional curb and gu er.
- Can be integrated into landscape design to improve aesthec appeal.

LIMITATIONS

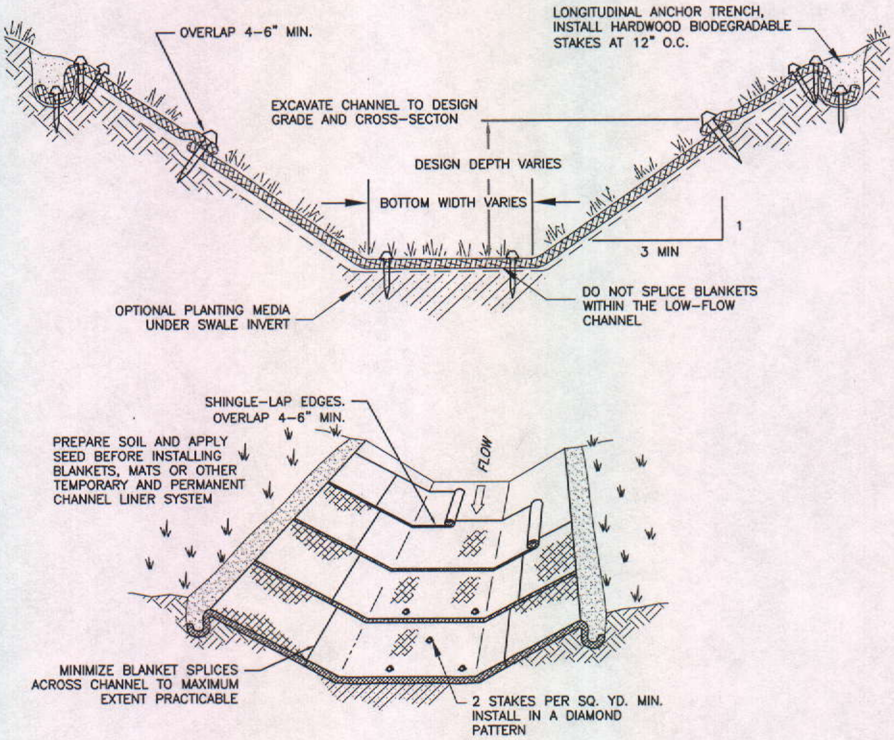
- Can be dicult t o avoid channelizaon, which ma y cause erosion and limit inltr aon pot enal.
- Not suitable for steep slopes.
- May not be appropriate for industrial sites or locaons wher e spills may occur.
- Best suited for small drainage areas with low o w rates.
- A thick vegetav e cover is needed for these features to funcon pr operly.

KEY DESIGN FEATURES

In order to receive runo volume reducon credits, vegetated swales must be designed in accordance with Treatment Control BMP 30 (TC-30) from the California Stormwater BMP Handbook, New Development and Redevelopment. Key design elements are summarized below:

VEGETATED SWALE

Fact Sheet SDM-6



VEGETATED SWALE TYPICAL INSTALLATION

- Maximum o w velocity from the design storm event shall not exceed 1.0 foot per second.
- Vegetated swales should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, whichever is less, at the design treatment rate.
- Longitudinal slopes between 0.5% and 2.5% are recommended.
- Provide sucien t length to achieve a desired treatment contact me of 10 minut es. Regardless of contact me, the swale should not be less than 100 feet in length.
- Implement check dams for longitudinal slopes > 2.5% as a means to reduce slopes and promote inltr aon. Space as required to maintain maximum longitudinal bo om slope < 2.5%.
- Implement entrance/outlet energy dissipaon measur es to limit erosion and promote retenon.
- Do not compact soils beneath vegetated swales.
- Trapezoidal channels are normally recommended but other congur aons, such as par abolic, can also provide substanal w ater quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in ll ar eas that are far enough from an adjacent slope to minimize the potenal f or gopher damage. Do not use side slopes constructed of ll, which ar e prone to structural damage by gophers and other burrowing animals.
- A diverse selecon of lo w growing, plants that thrive under the specic sit e, climac, and w atering condions should be specied. V egetaon whose gr owing season corresponds to the wet season are preferred. Drought tolerant vegetaon should be c onsidered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equaon, a t the peak of the design storm, and a value of 0.25 for Manning's n.

- If o w is to be introduced through curb cuts, place pavement slightly above the elevaon of the the v egetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.
- Swales must be vegetated in order to provide adequate treatment and reducon of runo . It is important to maximize water contact with vegetaon and the soil surf ace. For general purposes, select ne, close-gr owing, water-resistant grasses. Refer to the Placer County Landscape Design Guidelines for more informaon.
- If possible, divert runo (other than necessar y irrigaon) during the period of v egetaon es tablishment. Where runo div ersion is not possible, cover graded and seeded areas with suitable erosion control materials. Diverted runo mus t be managed and retained onsite to avoid violaon of the Phase II MS4 P ermit.
- Swales used as primary stormwater conveyance facilies (i.e. without high o w bypass) must be designed according to requirements in the Placer County Stormwater Management Manual. These swales will not qualify for volume reducon cr edits unless the design criteria speci ed abo ve are also sas ed.

SIZING DESIGN GOALS AND REQUIREMENTS

The Post-Construcon St orm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retenon v olume (V_{ret}) associated with vegetated swales. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percenle, 24-hour design s torm for Regulated Projects. The equaon f or determining V_{ret} is as follows:

$$\mathbf{V_{ret} = A_{imp} * V_{85} * (1/12)}$$

Where:

V_{ret} = stormwater retenon v olume (^{3});
A_{imp} = impervious area draining to vegetated swale (^{2}); and
V_{85} = Runoff volume from the 85th percenle, 24-hour design storm (in)

RUNOFF REDUCTION CREDIT REQUIREMENTS

- Vegetated swales must be designed in accordance with Treatment Control BMP 30 (TC-30 - Vegetated Swale) from the California Stormwater BMP Handbook, New Development and Redevelopment (available at www.cabmphandbooks.com).
- The maximum o w velocity for runo fr om the design storm event must be less than or equal to 1.0 foot per second.

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance pracces, state the pares r esponsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site speci c inspecon checkl ist. At a minimum, maintenance shall include the following:

- Inspect on a semi-annual basis to assess slope integrity, soil moisture, vegetav e health, soil stability, compacon, er osion, ponding, and sedimentaon.
- Mow at least once per year, but do not cut grass shorter than the design ow depth because the e ecv eness of the vegetaon in r educing ow velocity and pollutant removal may be reduced. Grass cungs should be removed from the swale and composted.
- Remove accumulated sediment when it is 3" deep or higher than the turf to minimize potenal c oncentrated ows and sediment resuspension.
- Irrigate only as necessary to prevent vegetaon fr om dying.
- Integrated pest management should be used for pest control. The designer should ideally select vegetaon that does not require ferliz ers.

- Reseed periodically to maintain dense turf.
- Remove trash or obstrucons tha t cause standing water.
- Prevent o -street parking or other acvies tha t can cause rung or soil c ompacon.

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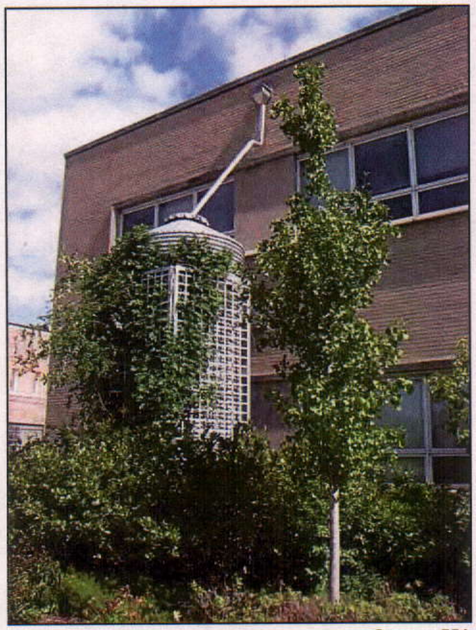
RAIN BARRELS AND CISTERNS

Fact Sheet SDM-7

Also known as: Rainwater Harvesng , and Rainwater Collecon

DESCRIPTION



Source: EPA

Rainwater harvesng is the pracce of collecng , conveying, and storing rainfall for future indoor and outdoor use such as landscape irrigaon, toilet ushing , and vehicle washing. The purpose of this harvesng is to collect high quality runo t o o set potable water demands while simultaneously reducing stormwater runo v olumes. Roo op runo is the stormwater most o en harvested for use because it typically contains lower pollutant loads than surface runo and pr ovides accessible locaons for collecon. Ho wever, runo fr om other clean impervious surfaces, such as driveways, walkways, and paos, ma y also be harvested e ecv ely.

Rainwater harvesng typic ally uliz es rain barrels or cisterns:

- Rain barrels are small containers, typically ranging from 50 to 100 gallons installed adjacent to individual downspouts to capture rainwater runo fr om roofs. Rain barrels are inexpensive, easy to install and maintain, and well suited to small-scale sites.
- Cisterns are typically much larger than rain barrels, ranging from 200 gallons for small installaons t o 10,000 gallons or more for large facilies. The y can be installed above or below ground, or even on the roof, depending upon site condions.

The irrigaon of har vested rainwater may uliz e a simple gravity system for small systems or use pumps for larger systems. The pump and wet well should be automated with a rainfall sensor to provide irrigaon only during periods when required inltr aon r ates can be realized.

ADVANTAGES

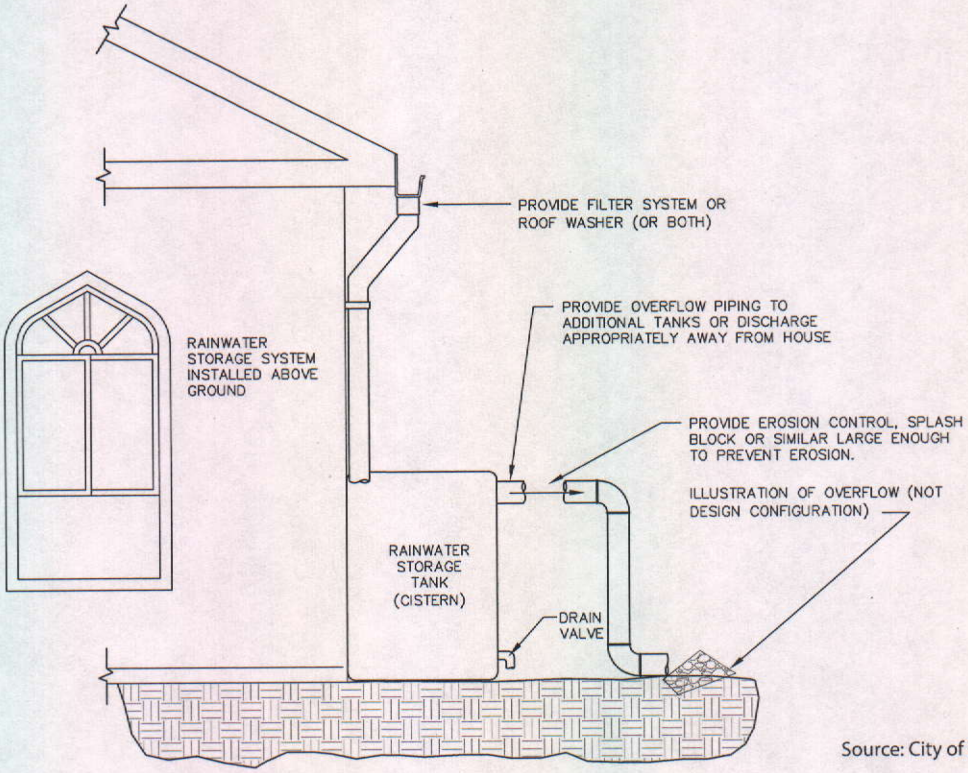
- Applicable with limited space constraints and under all soil condions.
- Reduces runo v olumes and peak ows while disconnecng imper vious surfaces.
- Does not add addional pollut ants to runo .
- Cisterns can be combined with pervious parking areas.
- Helps reduce demand on municipal treated water supplies.
- Can be retro ed into exisng pr operty.

LIMITATIONS

- Rain barrels have limited storage capacity.
- Stored runo mus t be used between storm events to maintain storage capacity.
- Does not provide water quality treatment.
- May require a system of pumps and valves to ll c ontainers and reuse stored water.
- Irrigaon s ystems may be expensive to operate and maintain.
- Inadequate maintenance can result in mosquito breeding and/or algae producon.
- May require building permits. Contact the governing agency for requirements.
- Reuse of harvested rainwater may involve regulatory obstacles.
- May require screening or landscaping to improve aesthecs.

RAIN BARRELS AND CISTERNS

Fact Sheet SDM-7



Source: City of Salinas

KEY DESIGN FEATURES

- Site storage tanks underground, indoors, on roofs, or adjacent to buildings, outside of exisng ulity easemen t and County right-of-way.
- Make tanks water gh t to avoid ponding or saturaon of soils within 10' of building f oundaons.
- Locate rain barrels or above ground cisterns with gravity distribuon s ystems up-gradient from irrigated areas.
- Locate underground cisterns in nav e, rather than ll soil for stability.
- Roof surfaces shall not include copper or materials treated with fungicides or herbicides.
- Roof gu ers must be fully screened and installed at connuous gr ade.
- Containers must be opaque, water gh t, vented, completely covered and screened.
- Pretreat runo t o remove debris, dust, leaves, and other debris. Use leaf and mosquito screens (1 mm mesh size), rst- ush diverter, or in-tank lter.
- Use seling c ompartment for tanks over 2,500 gallons.
- Use a water pump for underground cisterns. Indoor systems usually require a pump, pressure tank, back-up water supply line and back ow preventer.
- Overo w device must be equal in size to the total of all inlets and must lead to an approved discharge locaon with approved air gap.
- Install safety labels (non-potable, vector hazard, drowning hazard icons).
- Refer to local ordinances for sing and siz e constraints.
- Both rain barrels and above-ground cisterns must be sited in a stable, a t area. Rain barrels and cisterns may not block the path of travel for r e safety access.
- Overo w locaons, which c an include bioretenon units, addional r ain barrels or cisterns, or a discharge point to the storm drain system, must be designed to both direct oulo w away from building foundaons and prevent nuisance o ws to adjacent properes.
- Tanks should be opaque and placed in a cool or shaded area to avoid algal growth.

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RAIN BARRELS AND CISTERNS

Fact Sheet SDM-7

SIZING DESIGN GOALS AND REQUIREMENTS

Photo Source: City of Portland

The Post-Construcon St orm Water Quality Plan (SWQP) Form 3-4 should be used to calculate the retenon v olume (V_{ret}) associated with rain barrels and cisterns. This value is then used to calculate the area of impervious surface treated, and determine if other site design measures are necessary to capture the 85th percenle, 24-hour design storm for Regulated Projects. The equaon f or determining V_{ret} is as follows:

$$\mathbf{V_{ret} = N * Va * 0.5}$$

Where:

V_{ret}	= stormwater retenon v olume (^{3});
N	= number of rain barrels and/or cisterns; and
V_a	= average volume of rain barrels and/or cisterns (^{3})

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the SWQP. The maintenance plan shall include recommended maintenance pracces, state the pares r esponsible for maintenance and upkeep, specify the funding source for ongoing maintenance, and provide a site specic inspecon checklis t. Maintenance requirements for rainwater harvesng s ystems vary according to use. At a minimum, maintenance shall include the following:

- Perform regular inspecons e very six months during the spring and fall seasons for the following:
    - o Conrm tha t all the parts, pumps, and valves are operable and not leaking;
    - o Keep leaf screens, roof gu ers, and downspouts free of leaves and other debris;
    - o Check screens and patch holes or gaps;
    - o Clean and maintain rst ush diverters and lters, especially those on drip irrigaon s ystems;
    - o Inspect and clean storage tank lids, paying special a enon t o vents and screens on in ow and out ow spigots; and
    - o Replace damaged system components as needed.
- Clean tanks annually with a non-toxic cleaner, such as vinegar and dispose of wash water in a sink, bathtub or sewer cleanout.
- Flush cisterns annually to remove sediment. For buried structures, vacuum removal of sediments is required.
- Test all backo w prevenon assemblies f or proper funcon annually .
- Regular use of the water stored in systems between rain events is cric al to ensure that storage is available for the next storm event.

RAIN BARRELS AND CISTERNS

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BIORETENTION

Fact Sheet TR-1

Roadside bioretneon. Sour ce: sitephocus.com

Bioretenon f acilies, also kno wn as rain gardens and stormwater planters, are planted depressions that slow, treat, and inltr ate stormwater to improve water quality and manage hydromodic aon. They can be located in a variety of sengs such as along r oadsides or incorporated into a site's landscaping but should be designed by a qualied pr ofessional. Bioretenon cells r eceive runo fr om roofs and other impervious surfaces and provide treatment through seling , ltr aon, and biologic al processes as stormwater ponds and percolates through planng soil media and in to a subsurface gravel storage bed. Runo v olume is reduced by evapotranspiraon and, if condions ar e suitable, by inltr aon in to the underlying soils and groundwater. Bioretenon f acilies ar e e ecv e at removing a variety of pollutants including trash, sediment, metals, nutrients, bacteria and hydrocarbons. Bioretenon ar eas are usually designed to allow shallow ponding, with an overo w outlet to prevent ooding during heavy storms. The overo w can be directed to a storm drain system or to another BMP.

Two general types of bioretenon f acilies ar e allowable in the Permit including inltr ang bior etenon and o w-through planters. Flow-through planters are used in locaons not suit able for inltr aon and include impermeable liner s and an underdrain pipe to collect the treated water and discharge it to the municipal storm drain or other appropriate locaon.

ADVANTAGES

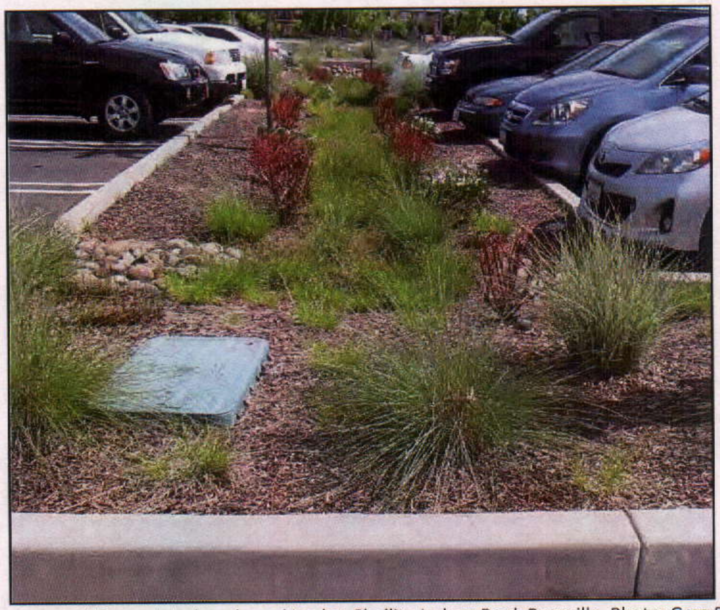
- Protects and improves water quality by removing pollutants from stormwater runo .
- Reduces surface runo v olumes and a enuates peak o ws.
- Wide range of scales and site applicability.
- Ar acv e and relav ely easy and inexpensive to install and maintain.
- Improves air quality and reduces heat island e ects.
- Increases groundwater recharge.
- Creates habitat and increases biodiversity.

LIMITATIONS

- Inltr aon of s tormwater can negav ely impact structural foundaons and incr ease other geological hazards. Locaons shall be appr oved by a licensed Geotechnical Engineer.
- High groundwater can slow inltr aon r ates or even seep into bioretenon cells and dischar ge as surface water. An average 10 ft. separation, and a minimum of 5 ft., between the bottom of the BMP and groundwater is recommended.
- Contaminants in soil and groundwater can be mobilized by inltr ang w ater.
- Exisng in frastructure such as underground ulies and dr ainage infrastructure may constrain bioretenon design.
- Vegetaon r equires maintenance and can look overgrown or weedy; seasonally it may appear dead.

KEY DESIGN FEATURES

The design of bioretenon f acilies in volves many consideraons and planning acvies should be s tarted at the earliest possible stage of a projects. It is cric al that the facilies achie ve the required performance standards while also protecng public health and sa fety, infrastructure and property. Bioretenon design should begin during the site assessment and layout phase when determining building and parking locaons and f ootprints and before the site grading plan is prepared. For inltr aon type planters, consult a licensed geotechnical engineer about site suitability.



LID vegetated swale parking lot. Shellito Indoor Pool, Roseville. Photo: Greg Bates

The key design features and consideraons f or bioretenon f acilies include the f ollowing:

1. Topography: In appropriate condions and with careful design, bioretenon f acilies c an be located on slopes by incorporang check dams, terracing, or other methods to pond the water. Inltr aon on slopes c an create, or increase, the potenal f or downgradient seepage, landslides, and other geotechnical hazards. Inltr aon is g enerally not recommended on slopes exceeding 10 percent.

2. Adjacent structures: Where bioretenon facilies ar e located next to structures such as curb and gu er, sidewalks, buildings, addional structural support may be required between the adjacent road or parking surface and bioretenon soil media. Verc al cuto w alls or impervious liners should be considered to keep stormwater from migrang in to structural ll or r oad base materials. In expansive (C, D) soils, locate stormwater planters far enough from structures to avoid damage to foundaons (as de termined by a structural or geotechnical engineer). 10 feet is a typical rule-of-thumb.

   Subsurface ulies should not be loc ated within the bioretenon f acility and ulity tr enches should be isolated from the inltr ang ar eas to prevent the formaon of pr eferenal o w paths along trenches, migraon of backll ma terials, and ooding of ulity v aults.

3. Inlet design: Inlets can include a variety of structures and congur aons including curb cuts, open channels, and pipes. The design must provide the width and geometry needed to direct o ws into the facility and its elevaon mus t provide adequate hydraulic head for ltr aon and s torage volume. To prevent stormwater runo from eroding the soil surface as it enters the facility, a concrete splash pad or rock energy dissipater (3"-5" -size rounded rock, 6" depth) should be placed at the inlets.

4. Overo w: Provisions to bypass o ws that exceed the design ponding depth must be included in bioretenon designs. Overo w systems should be located near the entrance of the bioretenon f acility to prevent scouring of the system and mobilizaon of the mulch la yer. Overo w provisions shall not impact structures. Overo w structures may consist of a raised overo w structure connected via pipe to an approved discharge point, or a surface conveyance route (e.g., curb cuts, open channel, or pipe). Overo w structures must be sized to convey peak ood o ws, per Placer County SWMM requirements, and include provisions for clogging. Elevaons mus t be set to provide storage of the required water quality volume.

5. Surface ponding: A minimum design depth of 6 inches is required for surface ponding to provide addional stormwater storage capacity, with a maximum depth of 12 inches. Ensure that the design does not allow ponding to persist for longer than 72 hours for vector control.

BIORETENTION

Fact Sheet TR-1

6. Aggregate layer: A minimum 12-inch thick layer of ¾-inch washed aggregate below the planng media incr eases the facility's water storage capacity and promotes posiv e drainage through the underdrain system. A 3-inch layer of smaller aggregate (washed pea gravel) between the planng media and ¾-inch ag gregate layer can omit the need for lt er fabric, which is known to cause clogging.

7. Bioretenon soil media: A minimum 18-inch thick mix ture of 60-70 percent sand meeng the specic aons of the American Society for Tesng and Ma terials (ASTM) C33 and 30-40 percent compost may be used to provide ltr aon of runo while supporng health y plant growth. It may be possible in some cases to use nav e soil or to amend the nav e soil so that it is suitable. Use of nav e soil will depend on the evaluaon of the crit eria in "Secon 3 - Sit e Assessment" as well as consideraon of s tructural needs and may require evaluaon b y a licensed Geotechnical Engineer.

8. Mulch: If the area will be mulched, inial e xcavaon dep th must ancipa te the total combined media depth, to avoid having to reduce soil depth during construcon t o accommodate mulch at nal gr ades. If mulch is used as a top dressing avoid wood chips or other material that will oa t and potenally clog o vero w structures. Mulch should not be installed just before or during the rainy season.

9. Underdrain: An underdrain system should be included with the discharge elevaon a t the top of the aggregate layer to convey runo not in ltr ated into the nav e soil to the stormwater system or other appropriate discharge point. The underdrain may be eliminated in areas of high groundwater, rapidly inltr ang soils or wher e connecon of the under drain to a surface discharge point or to a subsurface storm drain are infeasible. The perforaons in the under drain must be directed down or else water o wing through the planng media in to the gravel layer will immediately be collected and discharged through the underdrain. Maintenance access and cleanout ports should be provided so that underdrain system can be rounely inspect ed and cleaned as needed.

10. Liners: Facilies with documen ted high concentraons of pollut ants in underlying soil or groundwater, facilies located where inltr aon c ould contribute to a geotechnical hazard, and facilies loc ated on elevated plazas or other structures may incorporate in impervious liner and may locate the underdrain discharge at the bo om of the subsurface aggregate layer.

11. Plants: A list of nav e plant species for the Sacramento Valley is provided in the table below. Use a variety of trees, shrubs and herbaceous plant materials. Nav e grass meadows are especially e ecv e at controlling and treang storm water over a large area. Choose moisture-tolerant plants for the bo om of a bioretenon swale or basin. Choose plants that can tolerate both uctua ng water condions and drought condions for the side edges. Guidance on planng and general landscape design is provided in the Placer County Landscape Design Guidelines (Placer County Planning Services Division, 2013).

12. Pre-treatment: Runoff from industrial sites or locations where spills may occur or areas with excessive erosion or sediment sources should be pre-treated to address pollutants of concern prior to discharging into bioretention systems.

13. Underlying soils: Soils beneath the facility must be protected from compaction during construction activities. If soils have been compacted previously they should be ripped as deeply as necessary to loosen the soils and re-establish natural infiltration rates.

Sacramento Valley Nav e Plant List. Provided by the California Nav e Plant Society, Sacramento Valley Chapter, July 2015.

Botanic name	Common name	Height	Dry	Med Water	Wet	Full Sun	Part Shade	Shade	Deciduous/ Evergreen
ANNUAL PLANTS									
Collinsia heterophylla	Chinese Houses	1-2'		X			X		D
Eschscholzia californica	California Poppy	1-1.5'	X	X		X			D
Gilia capitata	Globe gilia	0.5-1'	X	X		X	X		D
GRASSES & GRASS-LIKE PLANTS									
Bouteloua gracilis	Blue gramma grass	1.5-2'	X			X			D
Deschampsia caespitosa	Tufted hair grass	1-2'		X	X		X		E
Elymus glaucus	Blue wildrye	1'	X	X		X			E
Elymus triticoides	Creeping wildrye	1-3'	X	X		X	X		D
Festuca californica 'Serpentine Blue'	Serpentine blue California fescue	2-3'	X	X		X	X		E
Festuca idahoensis	Blue Idaho fescue	1'	X	X		X	X		E
Festuca idahoensis 'Siskiyou Blue'	Siskiyou Blue Idaho fescue	2'		X		X	X		E
Leymus condensatus 'Canyon Prince'	Canyon prince lyme grass	4'	X	X		X	X		E
Leymus triticoides (Elymus triticoides)	Creeping wild rye	1.5-3'	X	X		X	X		E
Melica californica	California melic	1-3'	X				X		D
Muhlenbergia rigens	Deer grass	5'	X	X		X	X		E
Sporobolus airoides	Alkali sacaton	2'		X	X	X	X		D
Stipa cernua	Nodding needlegrass	2'	X			X	X		D
Stipa lepida	Foothill needlegrass	2-3"	X			X	X		D
Stipa pulchra	Purple needlegrass	2'	X				X		D
Carex barbarae	Santa Barbara sedge	1-3'		X	X	X	X	X	E
Carex pansa	California meadow sedge	0.5'	X			X	X		E
Carex praegracilis	Clustered field sedge	1-2'	X	X		X	X		E
Juncus balticus	Baltic rush or wire rush	1-4'		X		X	X		E
Juncus effusus	Common rush	1.5-2'		X	X		X		E
Juncus effusus var. brunneus	Common rush	3-4'		X	X	X	X		E
Juncus effusus var. pacificus	Common rush	2-3'		X		X	X		E
Juncus patens	California gray rush	1.5-2.5'	X	X		X	X		E
Juncus patens 'Carman's Gray'	Carman's California gray rush	1-2'		X	X	X	X		E
Scirpus robustus	Alkali bull rush	5-15'			X	X	X		E
Xerophyllum tenax	Bear grass	2-4'		X		X			D
PERENNIAL PLANTS									
Achillea millefolium	Common Yarrow	1-3'	X	X		X	X		E
Achillea millefolium 'Island Pink'	Island pink common yarrow	2'	X	X			X		
Acmispon glaber (syn. Lotus scoparius)	Deerweed	3'	X			X			E
Aquilegia exima	Serpentine columbine	2'	X	X			X	X	D
Aquilegia formosa	Western columbine	1.5-3'		X	X		X	X	D
Artemisia douglasiana	California mugwort	3-5'	X	X	X	X	X		E
Asarum caudatum	Wild ginger	1'		X	X		X	X	E
Asclepias cordifolia	Purple Milkweed	1-3'	X	X		X	X		D
Asclepias fascicularis	Narrowleaf milkweed	2-3'		X		X	X		D

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Sacramento Valley Nav e Plant List. Provided by the California Nav e Plant Society, Sacramento Valley Chapter, July 2015.

Botanic name	Common name	Height	Dry	Med Water	Wet	Full Sun	Part Shade	Shade	Deciduous/ Evergreen
PERENNIAL PLANTS CONT.									
Asclepias speciosa	Showy milkweed	3-6′		X		X	X		D
Carex tumulicola	Foothill Sedge	1.5′	X	X		X	X	X	E
Dudleya cymosa	Dudleya, Liveforever	3-6″		X			X	X	E
Epilobium canum	California fuchsia	1-1.5′	X	X					D
Epilobium canum 'Carman's Grey'	Carman's grey California fuchsia	2′	X	X		X	X		D
Epilobium canum 'Catalina'	Tall California fuchsia	1.5-3′	X	X		X	X		D
Epilobium septentrionalis 'Select	Select Mattole California fuchsia	0.25-0.5′		X		X	X		D
Equisetum scirpoides	Dwarf scouring rush	0.5′		X	X	X	X		E
Erigeron glaucus 'Wayne Roderick'	Seaside Daisy	0.5′		X		X	X		E
Erigeron karvinskianus	Mexican daisy, Santa Barbara daisy	1-1.5′		X		X	X		E
Eriodictyon californicum	Yerba Santa	3-6′	X	X		X	X		E
Eriogonum gracile	Wild buckwheat/ Slender	14-16″	X	X		X	X	X	D
Eriogonum grande var rubescens	Red-Flowered buckwheat	1-3′	X			X			E
Eriogonum umbellatum var. polyanthum	Sulfur buckwheat	0.5-1′	X	X		X	X		E
Eriogonum ursinum	Bear Valley buckwheat	0.25-1′	X	x		X	X		E
Eriophyllum lanatum	Woolly sunflower	1-2′	X			X	X		E
Fragaria vesca	Wild strawberry	4-6″		X	X	X	X	E	E
Grindelia stricta venulosa	Coastal gum plant	1-2′	X	X		X	X		E
Helenium bigelovii	Bigelow's sneezeweed	2-3′		X		X	X		D
Heuchera 'Canyon Quartet'	Canyon quartet alum root	1-2′	X	X			X	X	E
Heuchera 'Lillian's Pink'	Lillian's pink alum root	1-2′	X				X	X	E
Heuchera maxima	Island alum root	2-3′	X	X			X	X	E
Heuchera micrantha	Crevice alum root	1-2′	X	X			X	X	E
Heuchera 'Rosada'	Rosada alum root	2-3	X	X			X	X	E
Hibiscus lasiocarpus	Hibiscus	4-6′		X	X	X	X		D
Iris douglasiana	Douglas iris	1-2′	X	X		X	X		E
Iris Pacific Coast Hybrid 'Canyon	White Pacific Coast hybrid iris	1-2′	X	X		X	X		E
Iris Pacific Coast Hybrid 'Dorothea's	Burgundy Pacific Coast hybrid iris	1-2′	X	X		X	X		E
Iris Pacific Coast Hybrid 'Lavender'	Lavender Pacific Coast hybrid iris	1-2′	X	X		X	X		E
Iris Pacific Coast Hybrid 'Purple and	Purple and white Pacific Coast hybrid iris	1-2′	X	X		X	X		E
Iris Pacific Coast Hybrid 'Yellow'	Yellow Pacific Coast hybrid iris	1-2′	X	X		X	X		E
Iris Pacific Coast Iris mixed	Mixed colors Pacific Coast hybrid iris	1-2′	X	X		X	X		E
Lilium pardilinum	Leopard lily	3-8′		X		X	X		D
Linum lewisii	Blue Flax	2-3′	X	X			X	X	D
Lupinus polyphyllus	Streamside lupine	1-3′		X	X		X		D
Mentzelia laevicaulis	Blazing star	2-3′	X			X			D
Mimulus aurantiacus	Sticky monkeyflower	3-5′	X	X		X	X		E
Mimulus aurantiacus 'Verity',	Bush monkeyflower	1-4′		X		X	X		E
Mimulus cardinalis	Scarlet Monkeyflower	1 ½ -3′			X	X	X		D
Monardella odoratissima	Mountain pennyroyal, coyote mint	0.3-2′	X			X			E

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Botanic name	Common name	Height	Dry	Med Water	Wet	Full Sun	Part Shade	Shade	Deciduous/ Evergreen
PERENNIAL PLANTS CONT.									
Penstemon azureus	Azure penstemon	0.5-1.5′	X	X		X	X		D
Penstemon heterophyllus	Foothill penstemon	1-3′	X	X		X	X		E
Penstemon heterophyllus 'Margarita BOP'	Margarita BOP foothill penstemon	1.5-2′	X	X		X	X		E
Penstemon spectabilis	Showy penstemon	3-4.5′	X			X	X		E
Phacelia imbricate	Rock Phacelia, Pine Bee Flower	1-2′	X			X			D
Phyla nodiflora	Lippia	2-4"		X			X		D
Potentilla glandulosa	Sticky cinquefoil	1-2′		X		X	X		D
Rubus leucodermis	Western raspberry	3-4′		X			X		D
Rubus parviflorus	Thimbleberry	3-6′		X			X	X	D
Salvia 'Bee's Bliss'	Bee's bliss Sonoma sage	1-1.5	X	X		X	X		E
Salvia sonomensis	Creeping Sage	1′	X			X	X		E
Scrophularia californica	California figwort, Bee Plant	4-6′		X			X		D
Sedum obtusatum	Sierra sedum	0.5′	X	X			X		E
Sisyrinchium bellum	Blue-eyed grass	1′		X	X	X			D
Solidago californica	California goldenrod	1′			X	X	X		D
Solidago Californica 'Cascade Creek'	Cascade Creek California goldenrod	3-4′	X			X	X		D
Symphyotrichum chilense	California aster	2′	X	X	X	X	X		D
Whipplea modesta	Western whipplea	0.25-0.75′		X			X		D
Woodwardia fimbriata	Western chain fern	4-6′		X			X	X	E
Wyethia angustifolia	Narrowleaf mule's ears	20"	X	X		X	X		D
Wyethia mollis	Mountain mule's ears	0.5-2′	X	X			X		D
SHRUBS									
Arctostaphylos bakeri 'Louis	Pink manzanita	5-6′	X	X		X	X		E
Arctostaphylos densiflora 'Howard	McMinn's manzanita	5-8′	X	X		X	X		E
Arctostaphylos densiflora 'Sentinel'	Sentinel manzanita	6-8′	X	X		X	X		E
Arctostaphylos edmundsii 'Carmel Sur'	Carmel Sur manzanita	1-1.5′	X	X		X	X		E
Arctostaphylos 'Emerald Carpet'	Emerald carpet manzanita	1′	X	X		X	X		E
Arctostaphylos glauca	Bigberry manzanita	15′	X	X		X	X		E
Arctostaphylos hookeri 'Wayside'	Wayside Monterey manzanita	4′	X	X		X	X		E
Arctostaphylos 'John Dourley'	John Dourley manzanita	2-4′	X	X		X	X		E
Arctostaphylos manzanita 'Dr. Hurd'	Dr. Hurd's manzanita	10-12′	X	X		X	X		E
Arctostaphylos uva-ursi 'Green	Green Supreme bearberry	1′	X	X		X	X		E
Arctostaphylos uva-ursi 'Massachusetts'	Massachusetts bearberry	1′	X	X		X	X		E
Arctostaphylos uva-ursi 'Pacific Mist'	Pacific Mist bearberry	2-3′	X	X		X	X		E
Arctostaphylos uva-ursi 'Point Reyes'	Pt. Reyes bearberry	1′	X	X		X	X		E
Arctostaphylos uva-ursi 'Radiant'	Radiant bearberry	1′	X	X		X	X		E
Arctostaphylos viscida	Whiteleaf manzanita	4-12′	X			X			E
Atriplex lentiformis	Quail bush	3-10′	X			X			D
Baccharis pilularis	Coyote brush	4-8′	X			X			E
Baccharis pilularis 'Pigeon Point'	Pigeon Point coyote brush	1.5-3′	X	X		X			E

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Sacramento Valley Nav e Plant List. Provided by the California Nav e Plant Society, Sacramento Valley Chapter, July 2015.

Botanic name	Common name	Height	Dry	Med Water	Wet	Full Sun	Part Shade	Shade	Deciduous/ Evergreen
	SHRUBS CONT.								
Calycanthus occidentalis	Western Spicebush	8-15'		X	X		X	X	D
Carpenteria californica	California bush anemone	4-8'	X	X			X	X	E
Carpenteria californica 'Elizabeth'	Dr. McClintock's bush anemone	3-5'	X	X			X	X	E
Ceanothus 'Blue Jeans'	Blue jeans wild lilac	7-9	X			X			E
Ceanothus 'Centennial'	Centennial wild lilac	2'	X			X			E
Ceanothus 'Concha'	Concha wild lilac	6-7'	X			X			E
Ceanothus cuneatus	Buck brush	5-10'	X			X			E
Ceanothus 'Dark Star'	Dark Star wild lilac	5-6'	X			X			E
Ceanothus gloriosus	Pt. Reyes wild lilac	1-1.5'	X			X			E
Ceanothus gloriosus 'Anchor Bay'	Anchor Bay wild lilac	1-1.5'	X			X			E
Ceanothus gloriosus var. exaltatus	Emily Brown's hallelujah bush	1-2	X	X		X	X		E
Ceanothus griseus 'Louis Edmunds'	Louis Edmunds wild lilac	5-6'	X			X			E
Ceanothus griseus var. horizon. 'Yankee Point'	Yankee Point wild lilac	2-3'	X			X			E
Ceanothus griseus var. horizontalis	Carmel creeper wild lilac	1.5-2.5'	X			X			E
Ceanothus integerrimus	Deerbrush wild lilac	3-7'	X			X	X		D
Ceanothus 'Joan Mirov'	Joan Mirov wild lilac	3-6'	X	X		X	X		E
Ceanothus 'Joyce Coulter'	Joyce Coulter wild lilac	2-5'	X			X			E
Ceanothus 'Julia Phelps'	Julia Phelps wild lilac	5-7'	X			X			E
Ceanothus maritimus 'Point Sierra'	Pt. Sierra wild lilac	2-3'	X			X			E
Ceanothus maritimus 'Valley Violet'	Valley Violet wild lilac	2-3	X			X	X		E
Ceanothus 'Owlswood Blue'	Owlswood blue island wild lilac	10'	X	X			X		E
Ceanothus prostratus	Squaw carpet	1'	X	X			X		E
Ceanothus 'Ray Hartman'	Ray Hartman wild lilac	12-20'	X			X			E
Ceanothus thyrsifolius repens 'Louis Edmunds'	Louis Edmunds prostrate blue blossom	0,5-2'	X	X		X	X		E
Ceanothus thyrsiflorus	Blue blossom	5-15'	X			X			E
Ceanothus thyrsiflorus 'Skylark'	Skylark compact blue blossom	3-6'	X			X			E
Ceanothus thyrsiflorus 'Snow Flurry'	Snow flurry wild lilac	6-10'	X			X			E
Cercocarpus betuloides	Mountain Mahogany, Birchleaf Mountain Mahogany	10-15'	X			X	X		E
Cercocarpus betuloides var blancheae	Island mountain mahogany	10-12'	X	X		X			E
Cornus stolonifera (syn. C. sericea)	redtwig or western dogwood	7-9'		X	X		X		D
Cornus stolonifera 'Peter's Choice'	redtwig or western dogwood	7-9'		X	X		X		D
Eriogonum fasciculatum (E. f. var. foliolosum)	California buckwheat	1-3	X	X		X			E
Eriogonum giganteum	St. Catherine's lace	3-4'	X	X		X			E
Frangula tomentella	Hoary coffeeberry	6-10'	X	X		X	X		E
Fremontodendron 'Ken Taylor'	Ken Taylor flannel bush	4-6'	X			X			E
Fremontodendron 'Pacific Sunset'	Pacific Sunset flannel bush	12-15'	X			X			E
Fremontodendron 'San Gabriel'	San Gabriel flannel bush	15-20'	X			X			E
Garrya elliptica 'Evie'	Evie coast silktassel	8-15'	X			X			E
Garrya elliptica 'James Roof'	James Roof coast silktassel	8-15'	X			X			E
Heteromeles arbutifolia	Toyon	8-15'	X			X	X		E